
Space Weather Technical Forecast

Issued on Wednesday, 18 September 2024 at 00:11 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales <https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales>

Space Weather Forecast Headline: CME influences gradually declining on Day 1 (18 Sep). Chance of S1/Minor Radiation Storm. Ongoing Chance of M-class flares.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Activity measured at GOES16 and 18 was Low with only C-class flares observed in the past 24 hours, with the largest a C4.4 observed at 17/0640UTC from AR3828 in the southeast quadrant. Slight Chance of X-class flares, mainly from AR3825, and perhaps AR3824.

There are currently six sunspot regions on the visible disc, one of which is unnumbered. AR3825, in the southeast, remains the largest and most complex region on the disc. This region continued to see proliferation of its leading spot, with a delta configuration. This region remains perhaps the most noteworthy group due to its history of X-class activity. AR3824, in the southwest, has seen some consolidation of its leading spots, although this is becoming more difficult to analyse due its viewing angle. AR3829 in the northwest was numbered. AR3814 has rotated off the disc and AR3822 faded to plage. The remaining regions are relatively small and stable.

No Earth-directed Coronal Mass Ejections (CMEs) were in evidence in the period.

Solar Wind / Geomagnetic Activity: Solar wind parameters, as observed by ACE at L1, continued to show the effects of the CME, which arrived late on the 16 Sep. Solar wind speeds started the period at elevated to strong levels, reaching a peak of 649km/s at 17/0700UTC, before gradually declining to the current slightly elevated levels, near 450km/s. The phi angle was predominately positive (away from the Sun). The solar wind density was average to below average. The IMF was strong with peak of 20nT at 17/0137UTC, recently declined to moderate levels. The north-south component was predominately negative (southward) due to the CME arrival, varying between +8 and -18nT.

The net result of the above solar wind measures was a peak G4/Severe Geomagnetic Storm (Kp 8) interval (17/0000-0300 UTC) before gradually declining to current Unsettled (Kp3) to Active (Kp4) conditions.

Energetic Particles / Solar Radiation: High energy (greater than 10 MeV) proton flux observed by GOES18 was slightly above normal background levels following the X4.5 flare on 14 September. Levels rose to S1/Minor Solar Radiation Storm around 17/0725 UTC, but have now declined to below the S1 threshold.

High energy electron flux (greater than 2MeV) observed by GOES16, generally varied on a diurnal cycle between Normal Background to High levels, peaking at 2394pfu at 17/0130UTC. Since the arrival of the CME late on 16 Sep, electron levels have returned to background levels. The associated 24-hour fluence showed a generally flat trend, with 1.01e7 integrated pfu observed at 18/0000UTC.

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Four-Day Space Weather Forecast Summary

Solar Activity: Low to Moderate activity is forecast, with a Chance of M-class flares, most likely from AR3824 or AR3825. There is an ongoing Slight Chance of an isolated X-class flare from AR3825. No significant regions are expected to arrive or depart in the period and the risk is deemed largely constant as a result.

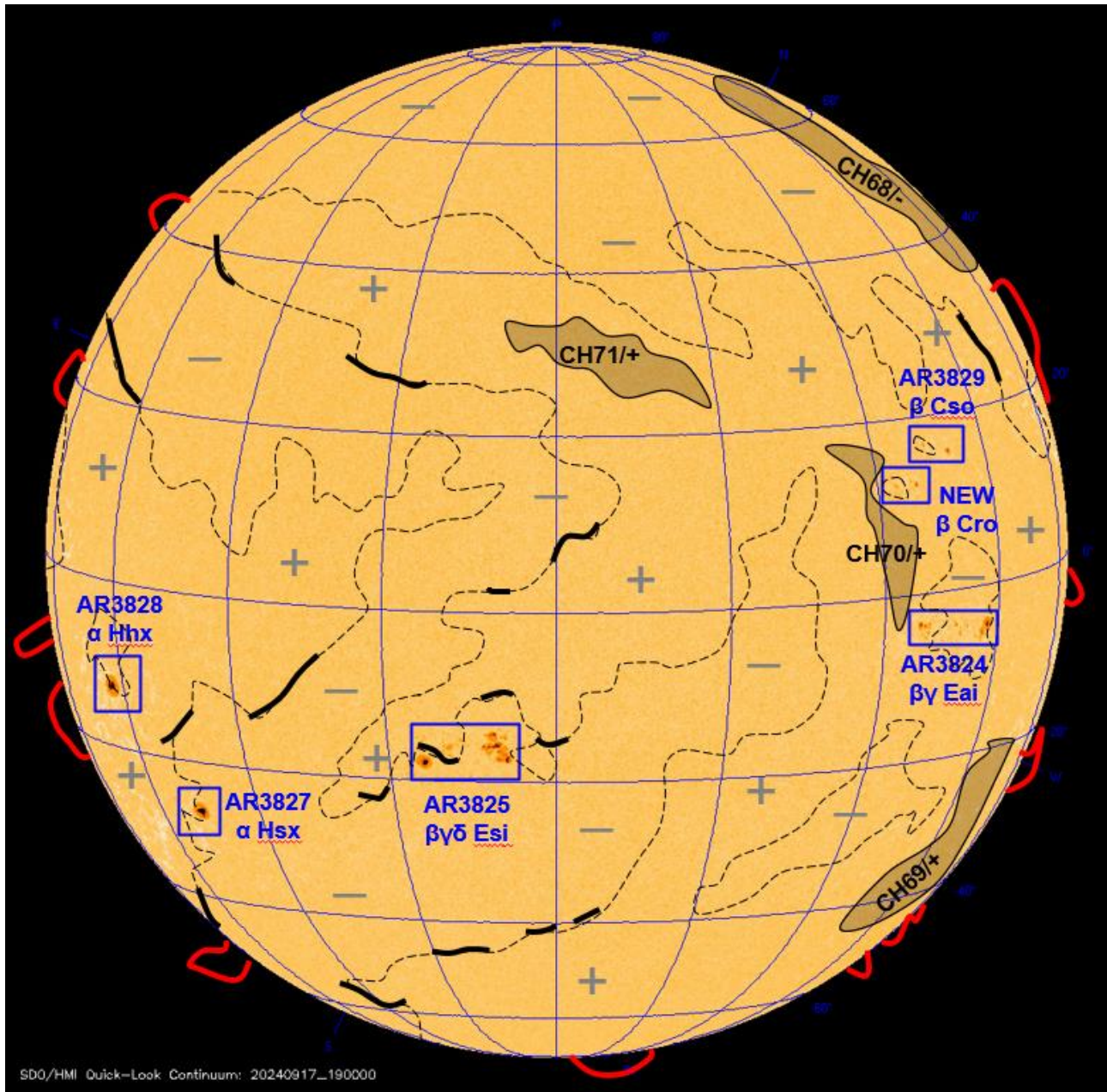
Solar Wind / Geomagnetic Activity: The effects of the CME from the X4.5 flare on 14 Sept, which arrived late on the 16 Sept, are beginning to gradually wane. Solar winds will continue to be Slightly Elevated, possibly increasing back up to Elevated levels due to the onset of a possible coronal hole fast wind (CH70/+), which may arrive late on Day 1 or Day 2 (18-19 Sep). No other Earth-directed feature in the forecast.

Geomagnetic activity is most likely to be Unsettled or Active on Day 1 (18 Sep), with a slight chance of reaching G1/Minor Storm levels if the fast wind from CH70/+ occurs late on Day 1 or Day 2 (18-19 Sep). Quiet conditions are likely from Day 3 (20 Sep).

Energetic Particles / Solar Radiation: High energy proton flux at GOES18 is currently just below the S1/Minor Storm threshold, which should continue to decline on Day 1 (18 Sep) and returning to background by Day 2 (19 Sep). Slight chance of S1 later in the period takes into consideration the potential for enhancement from AR3824 and/or AR3825.

High energy electron flux should continue to show suppression followed by a rebound later in the period as a result of the arrived CME(s), but all within Slight Chance of Active 24-hour fluence. CH70/+ not felt likely to be impactful.

Figure 1. Solar Analysis Valid 17/1900 UTC.



Key: Filament — , Prominence — , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

Geomagnetic Storms:

A CME arrived at L1 late on 16 Sept and observed as a shock on BGS Magnetometers around 17/0130UTC. This is considered to comprise of up to two CMEs, but with the majority of the contribution from the CME that left the Sun on 14 Sep associated with the X4.5 flare from AR3825. A CME from 13/0930UTC from an M2.9 flare from AR3814 may also have been swept up in this CME arrival. ACE EPAM LEMS showed a very slight rise prior to this arrival, however the lead time was very short (tens of minutes). The resultant response in Geomagnetic Activity was a peak G4/Severe Geomagnetic Storm (Kp 8) interval before gradually declining to current Active (Kp 4) intervals.

The fast wind forecast is probably of lesser consequence. A positive fast wind is perhaps now considered to already be in evidence and CH69/+ may have arrived as early as Saturday 14 September. A second small positive coronal hole near centre disc (CH70/+) may bring further Slightly Elevated to Elevated wind speeds at Earth for a time later Day 1 and into Day 2 (18-19 Sep), prolonging a Slight Chance of G1 before waning to leave Quiet (Kp 0-2) conditions by Day 3 (20 Sep).

Geo-Magnetic Storm	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Minor or Moderate	G1 to G2	Yes	10	10	1	1
Strong	G3	Yes	1	1	1	1
Severe	G4	Yes	1	1	1	1
Extreme	G5	No	1	1	1	1

Radio Blackouts - X-Ray Flares:

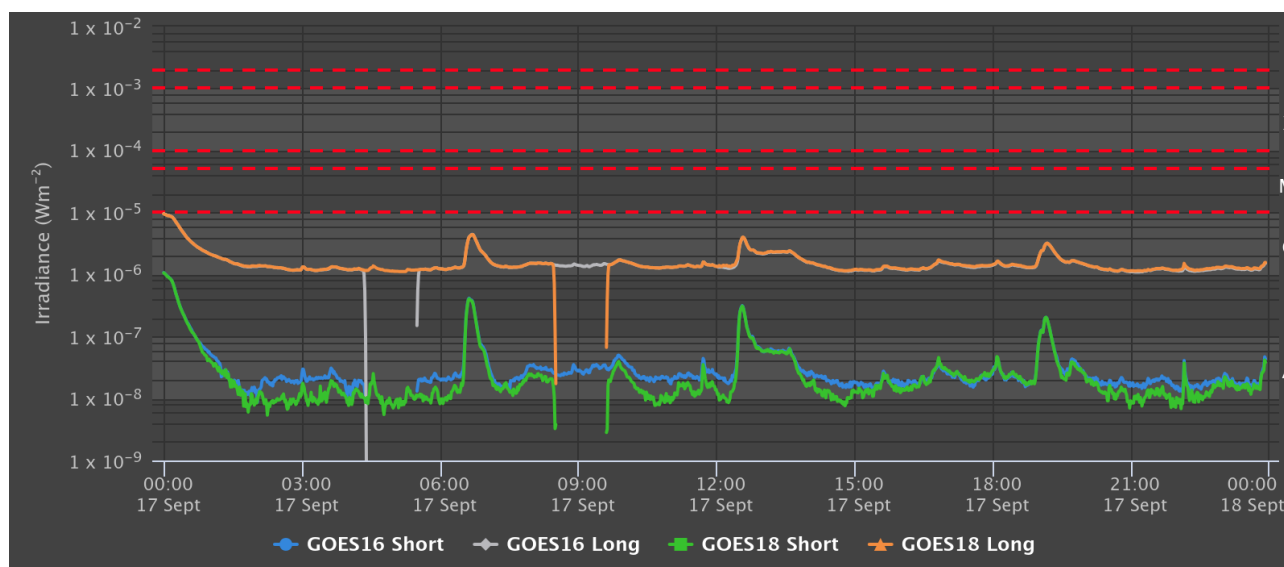
There are currently six sunspot regions on the visible disc, one of which is unnumbered. AR3825 (Esi/Beta-Gamma-Delta), in the southeast, remains the largest and most complex region on the disc. This region continued to see proliferation of its leading spot, with its delta configuration. This region remains perhaps the most noteworthy group due to its history of X-class activity. AR3824 (Eai/Beta-Gamma), in the southwest, has seen some consolidation of its leading spots, although this is becoming more difficult to analyse due its viewing angle. AR3829 (Cso/Beta) in the northwest was numbered. AR3814 has rotated off the disc and AR3822 faded to plage. The remaining regions are relatively small and stable.

Both of these dominant regions remain on the disc for almost the entire four days, with AR3824 reaching the limb by the end of the UTC working week on Day 3 (20 Sep). No significant regions are expected over the eastern solar horizon in the same interval, and the daily risk of flares is therefore held constant throughout.

Overall, the chance of M-class flares is maintained with a slight chance of X-class flares. The X-class level is above raw probabilities due to recent history of X-class activity from AR3825.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	40	40	40	40
Very Active	R3 to R5 X Class	No	10	10	10	10

Figure 2: GOES X-Ray flare trace



Solar Radiation Storms - (High Energy Protons):

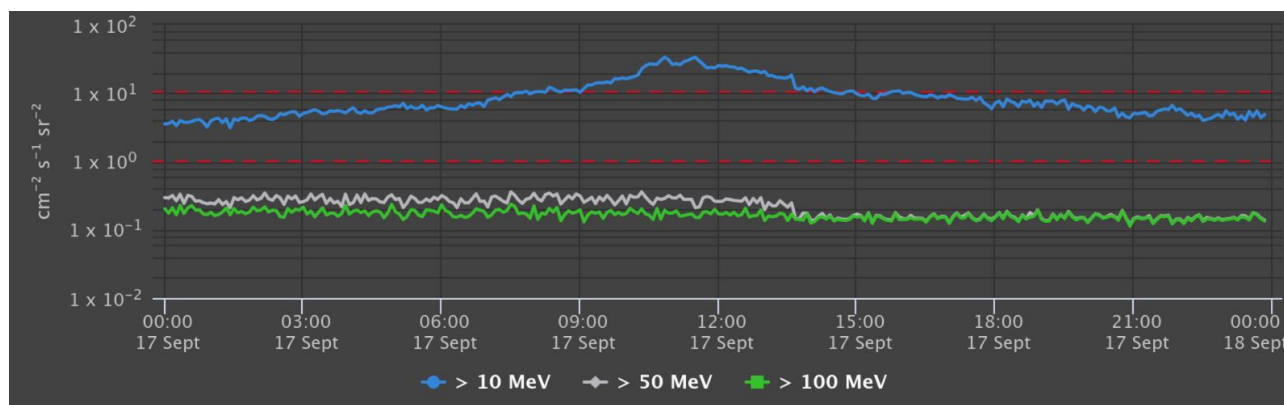
High energy proton flux at GOES18 reached the S1/Minor Radiation Storm level at 17/0725 UTC, but has since declined below the threshold. There is a chance of new enhancements during the forecast period, this would be more likely from AR3824 given its more favourable position in the western solar hemisphere, but AR3825 in the southeast may also act as a source in the event of any significant activity, having previously produced a proton response.

High energy proton flux levels are expected to continue to wane Day 1 (18 Sep) and returning to background by Day 2 (19 Sep). The slight chance of S1 later in the period takes into consideration the potential for enhancement from AR3824 and/or AR3825.

Radiation Storms	Level ($\text{cm}^{-2} \text{sr}^{-1} \text{s}^{-1}$)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	$\geq \text{S1}$	Yes	40	10	10	10
Very Active	$\geq \text{S3}$ *	No	1	1	1	1

* $\text{S3} \geq 10 \text{ MeV} \geq 1000 \text{ pfu}$ and / or $\geq 50 \text{ MeV} \geq 10 \text{ pfu}$. (pfu = $\text{cm}^{-2}\text{sr}^{-1}\text{s}^{-1}$)

Figure 3: GOES18 Proton Flux – shows the recent S1/Minor Radiation Storm in the past 24 hours.



High Energy Electrons Event ($\geq 2\text{MeV}$):

High energy electron flux is currently at background following the arrival of the CME arrival late on 16 Sep. Flux levels at GEO are displaying apparent suppression, although a rebound is anticipated later in the coming UTC week. The recovery in flux levels and charging associated with the CME arrival may see the return to a diurnal variation of background to moderate, perhaps peaking at high during diurnal maximum.

The anticipated onset of a fast wind from CH70/+ during Days 1 or 2 (18-19 Sep) is not expected to influence the forecast greatly, but there is a slight chance that it may act to further suppress and delay the electron flux recovery.

The forecast is therefore uncertain, but should continue to exhibit a suppression and then rise to a stable elevated level. This is represented by variations on a Slight Chance throughout. MOSWOC REFM is not considered to be useful in this instance given the dominance of recent CME influences.

GEO Electron Environment	Level ($\text{cm}^{-2} \text{sr}^{-1} \text{day}^{-1}$)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	$\geq 2 \text{ MeV}$ $\geq 1 \times 10^8$	No	1	10	20	20
Very Active	$\geq 2 \text{ MeV}$ $\geq 1 \times 10^9$	No	1	1	1	1

Figure 4: MOSWOC REFM electron fluence.

